



Diverse Sensing for Synergistic Protection in Urban Threat Environments

Demonstration Results



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29 April, 2010

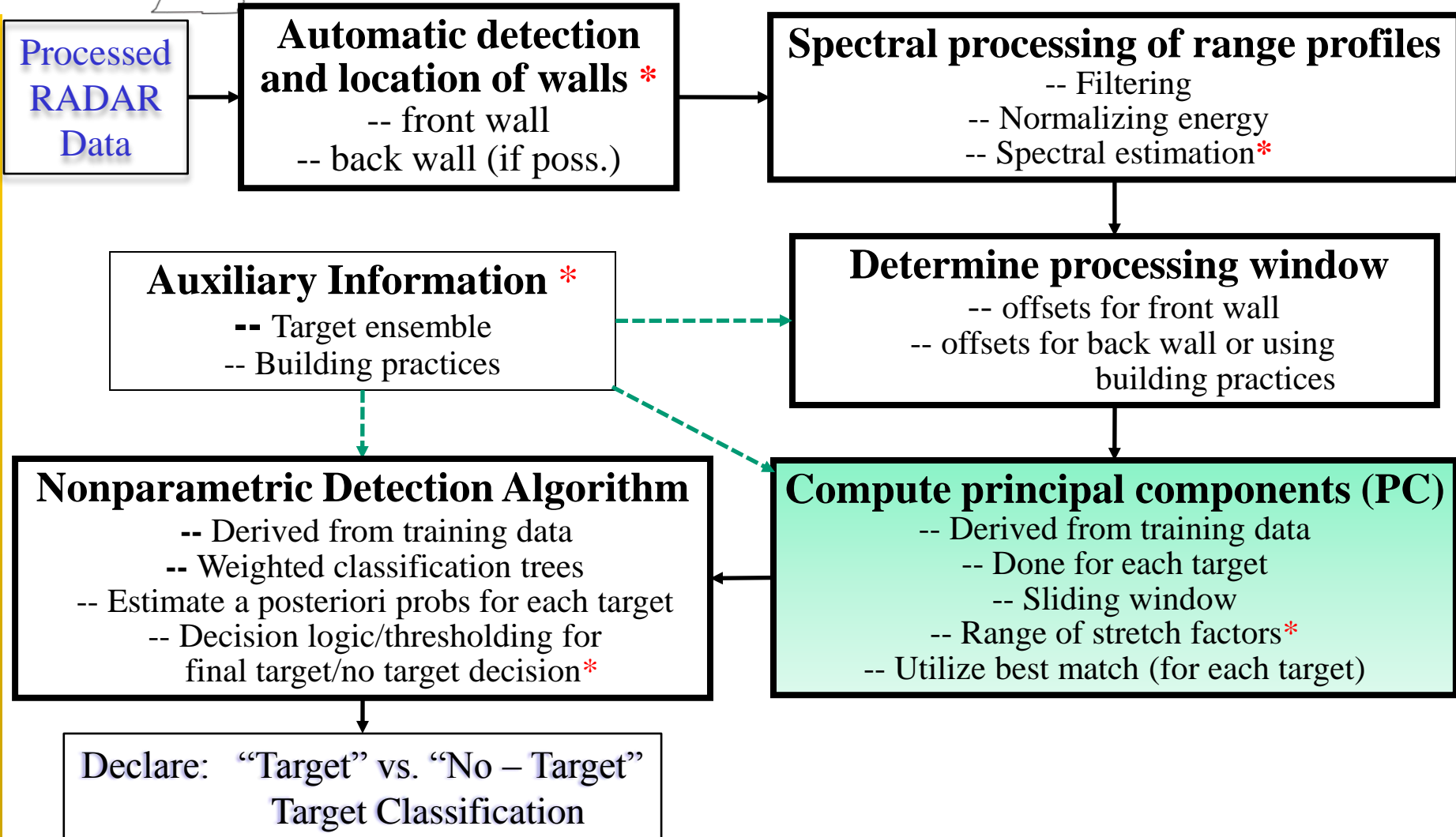
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Objective

- Show reasonable time, automated algorithm performance of pre-shot cueing algorithm on live, blind test collected data

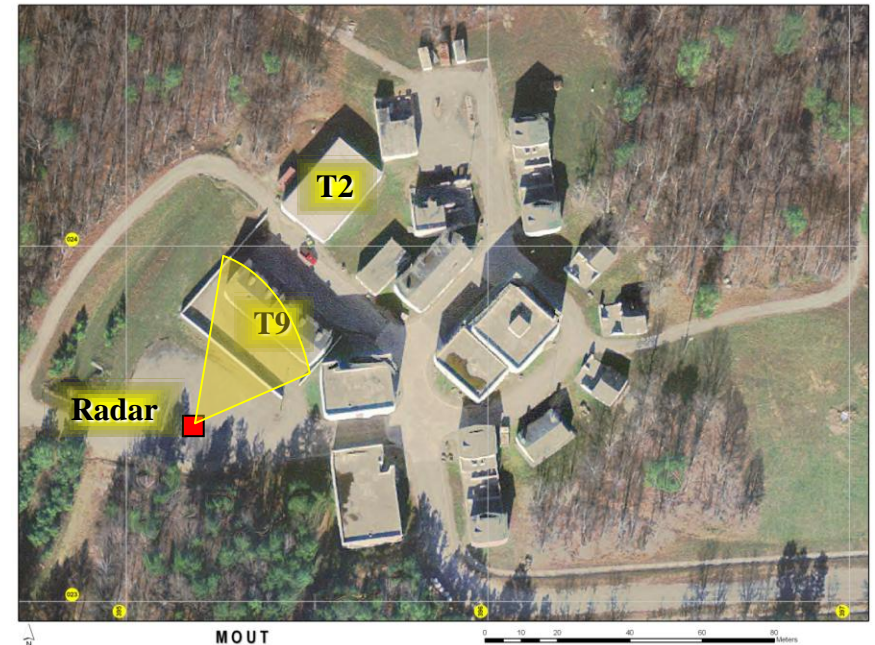
Automated Detection Algorithm Flow Diagram



* Corresponds to a significantly new component for this program

Demonstration Location

- Ft. Pickett MOUT site
- Deployment at 'Warehouse building' (T9)
- Processing/display at 'Schoolhouse' building (T2)



MTRIs Rotating Antenna Stage

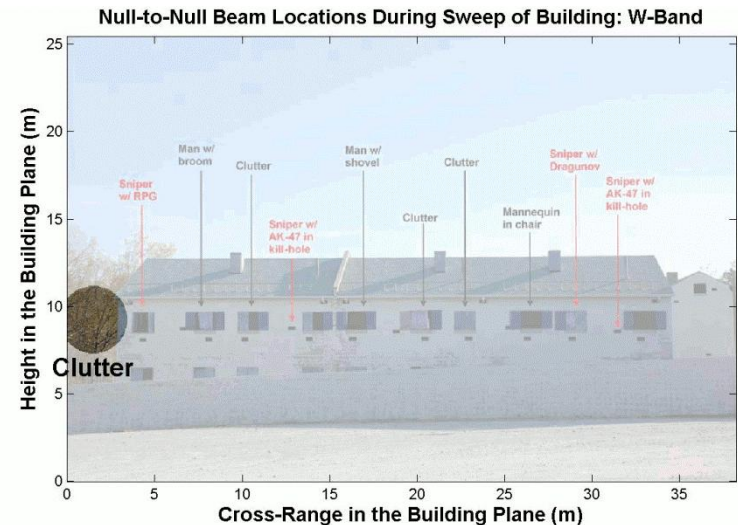
- Antenna head mounted on adapter for servo-controlled rotation stage
 - provides estimates of antenna azimuth



- Collection used continuous rotation rate of $0.2^\circ/\text{s}$ with frequency sweep rate of 2 Hz
 - **emulates a rotating antenna at $200^\circ/\text{s}$ with 2 kHz frequency sweep rate**

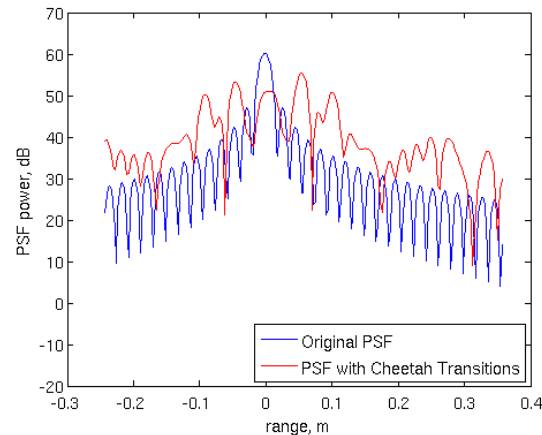
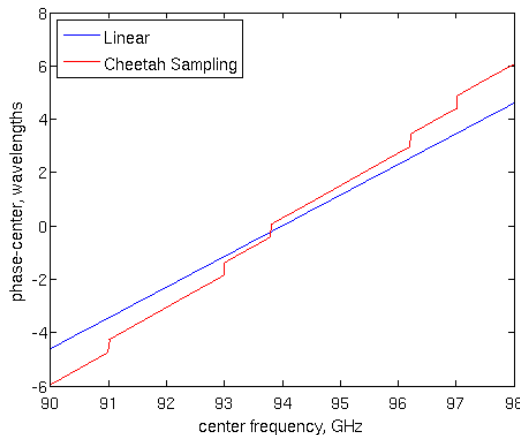
Demonstration Structure

- Azimuth scan on single building
 - Set up time too long to move, re-align instrumentation system
- Confusers/targets need to remain 'still' during illumination
 - Long sweep time of instrumentation radar (100 msec) and short wavelength (3mm, W band) make data susceptible to scintillation and smear
 - Field operational Radars have much faster sweep times (<100usec) which will effectively 'freeze' signatures
- Targets will be > 1 foot behind plane of walls
 - EO system will see threat if exposed at opening
- Radar and target will have direct line of site and have weapon pointed at Radar
 - Threat is defined as weapon pointed at vicinity of Radar



Measures to Mitigate Scene Motion

- Long chirp time (100ms) and non-uniform filter transition time coupled with small wavelength (W band) creates phase anomalies in moving targets

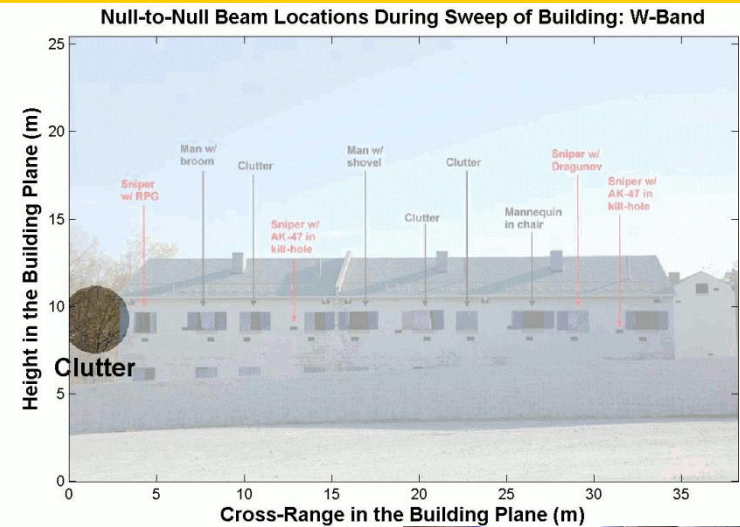


- Used monopods in Demo to mitigate PRF spoilage due to range-relative target motion



Demonstration Structure

- Scan set #1
 - False alarm testing
 - Scan #1: building with confuser targets
 - Empty rooms, people, people with implements
 - » Positioning of people determined on site with government
 - Scan #2: completely empty building, shutters open
 - Scan #3: empty building with shutters closed
- Inspection of processing results
- Scan set #2
 - Detection testing
 - 3 Scans
 - 4 Weapons
 - RPG-7, Dragunov, AK-47, AR-10
 - Positioning of target determined on site with government
 - Confusers added as resources permit





Demo April 2010

Detection Results

- Demo performed under TARDEC supervision
 - TARDEC chose deployment scenarios in real time
- Deployment of weapons and confusers under control of TARDEC
 - Weapons: RPG, Dragunov, AK-47, AR-10
 - Confusers: Person, person with tripod, person with broom
 - 6 building scans: 2 empty building, 4 with weapons/confusers
- Automated detection system
 - Data moved from collection system to detection system via data stick
 - All parts of detection system were automated
- Demo handled as a blind test
 - Truth was not used during testing, only for display purposes

Demo April 2010

Detection Results – tp9037

Scenario

Empty building,
shutters open

Munitions

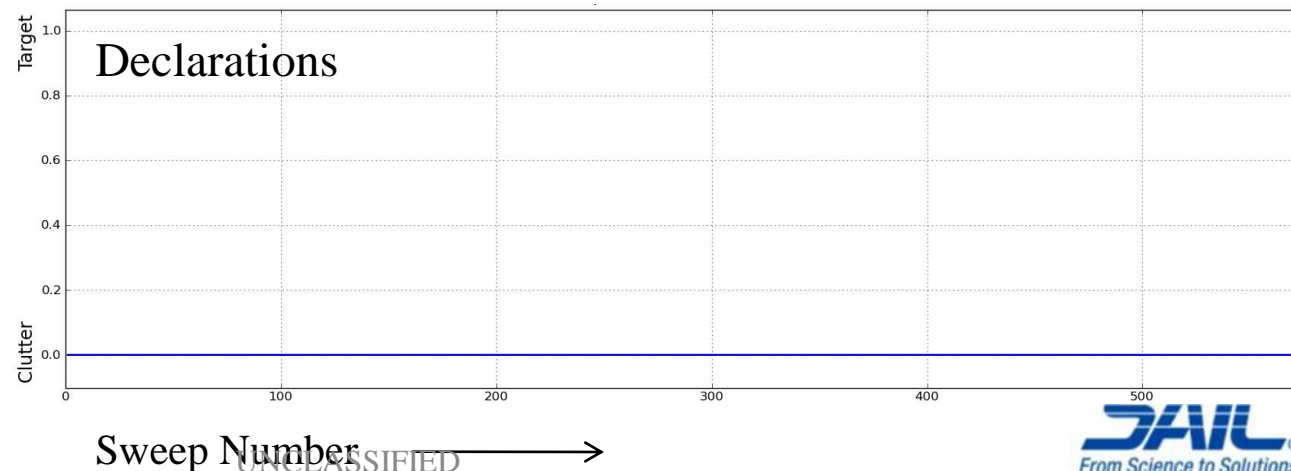
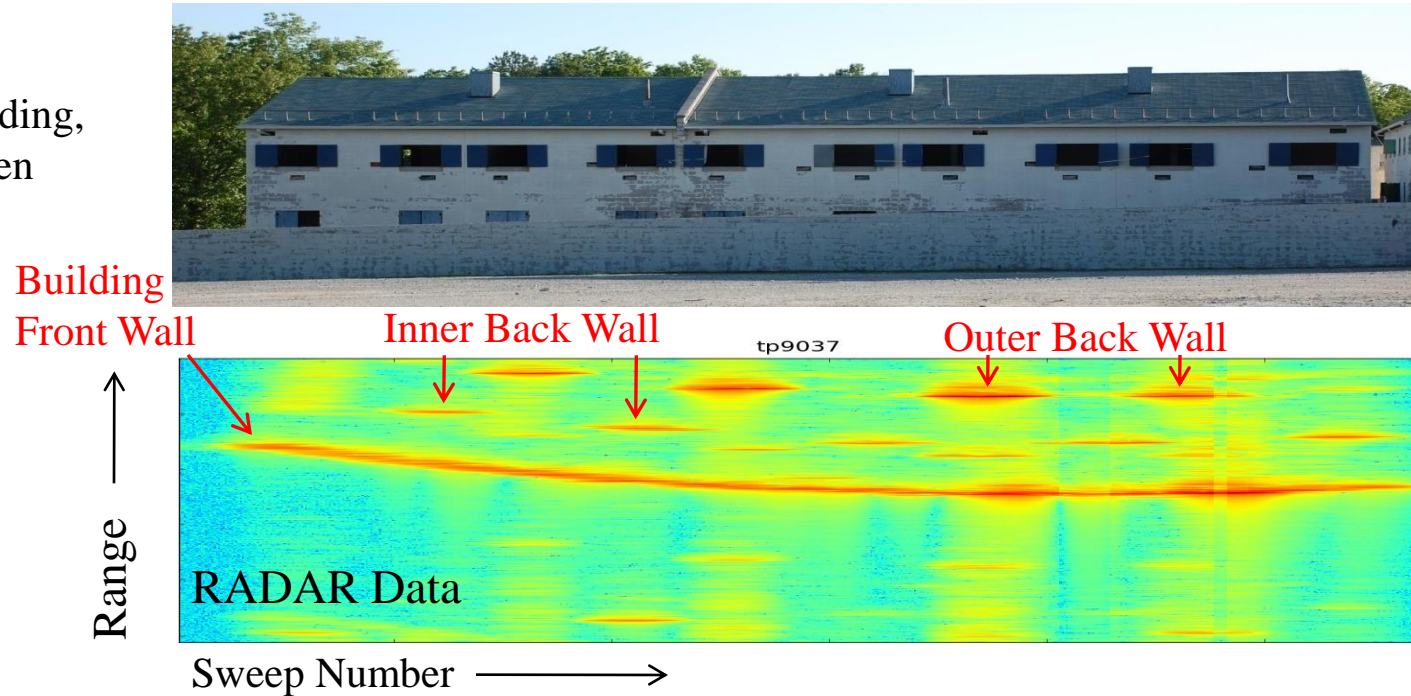
- None

Confusers

- None

Results

- No false alarms





Demo April 2010

Detection Results – tp9038

Scenario

Empty building,
people as
confusers

Munitions

- None

Confusers

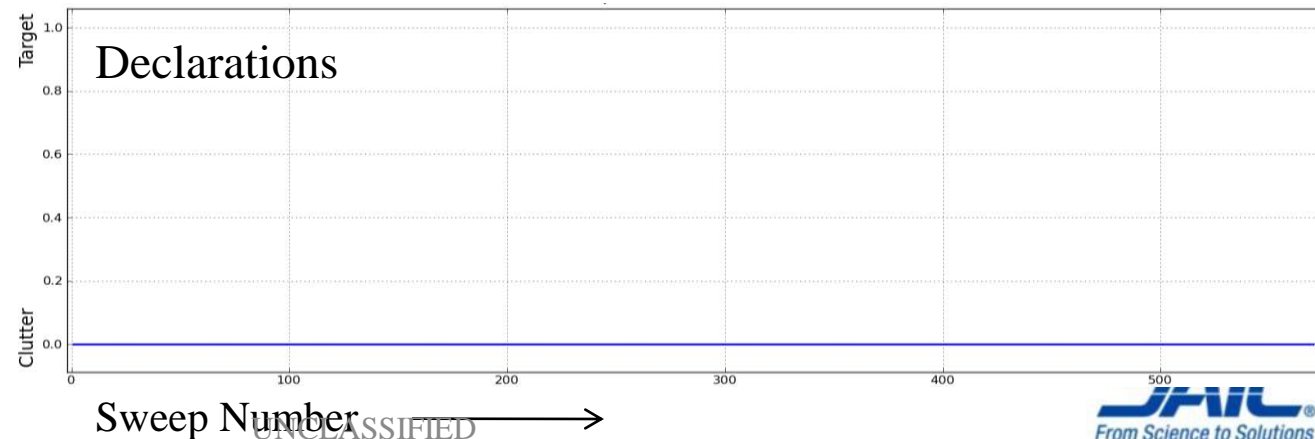
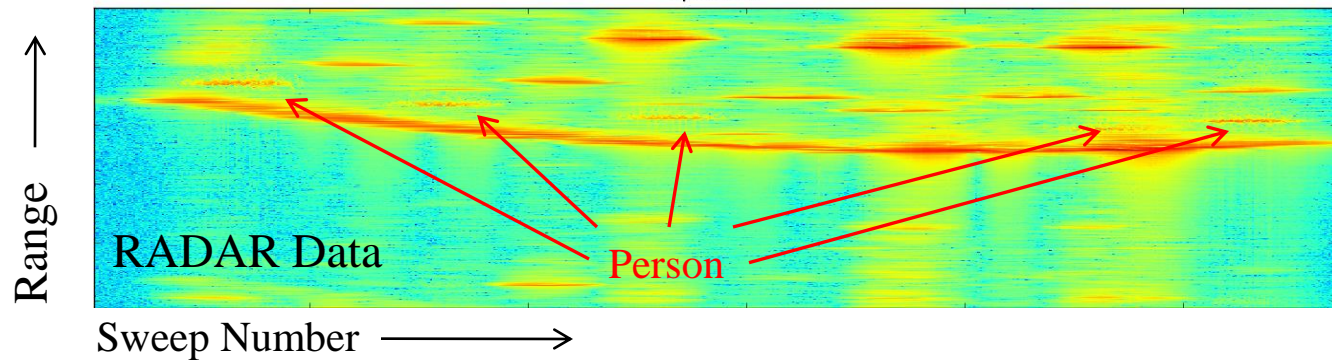
- Person

Results

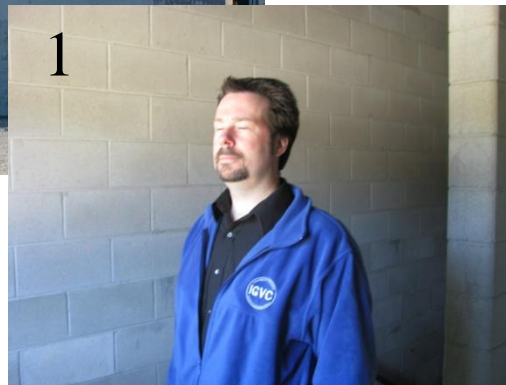
- No false alarms



tp9038



Deployed Persons





Demo April 2010

Detection Results – tp9039

Scenario

Empty
building, shutters closed

Munitions

- None

Confusers

- None

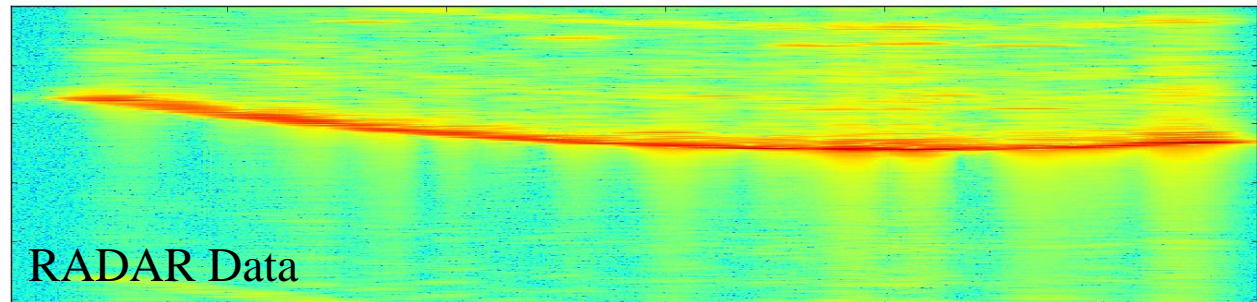
Results

- No false alarms



tp9039

Range
↑



Sweep Number →

Target
1.0
0.8
0.6
0.4
0.2
0.0
Clutter

Declarations

Sweep Number →

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Detection Results – tp9040

Scenario

Munitions

- Dragunov
- RPG
- AK47
- AR10

Confusers

- Person with Tripod

Results

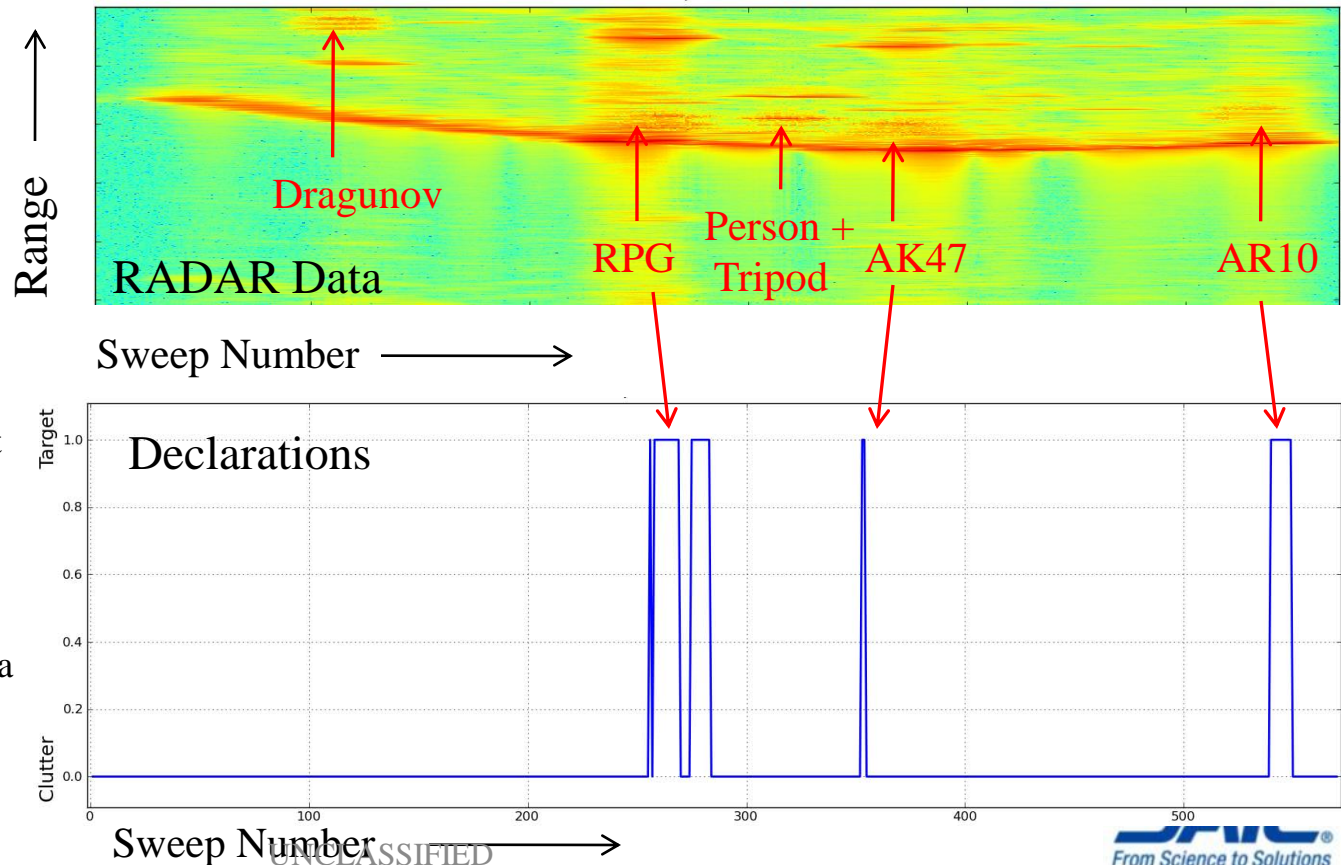
- RPG, AK47, AR10 detected as weapons
- Dragunov was missed
- Person+Tripod was not a false alarm

Notes

- Dragunov was in back room, outside search area



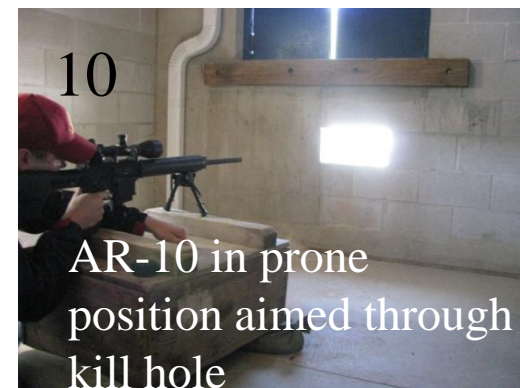
tp9040



Deployed Persons



Confuser targets
aimed at
RADAR



AR-10 in prone
position aimed through
kill hole

Demo April 2010

Detection Results – tp9041

Scenario

Munitions

- RPG
- AK47
- AR10
- Dragunov

Confusers

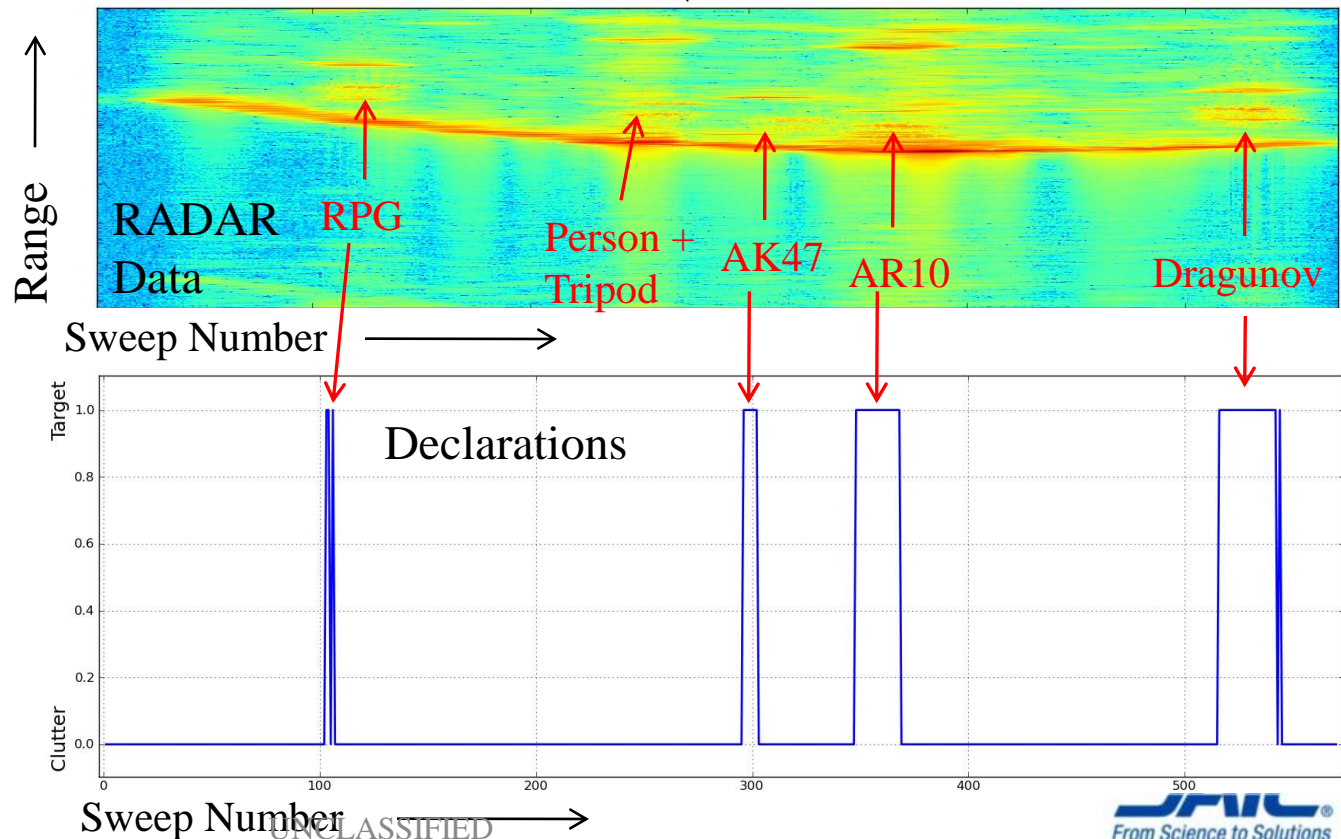
- Person with Tripod

Results

- RPG, AK47, AR10, and Dragunov detected as weapons
- Person+Tripod declared as clutter

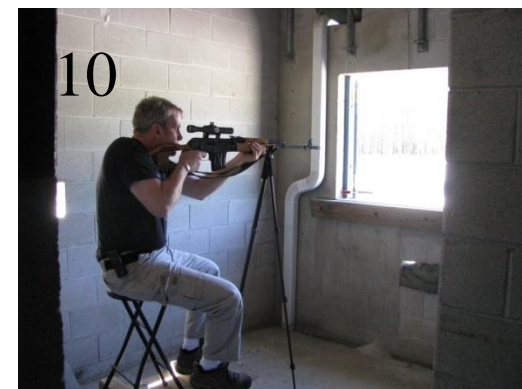


tp9041



Deployed Persons

Confuser targets
aimed at
RADAR



Demo April 2010

Detection Results – tp9042

Scenario

Munitions

- Dragunov
- AK47
- RPG
- AR10

Confusers

- Person with Tripod
- Person with Broom

Results

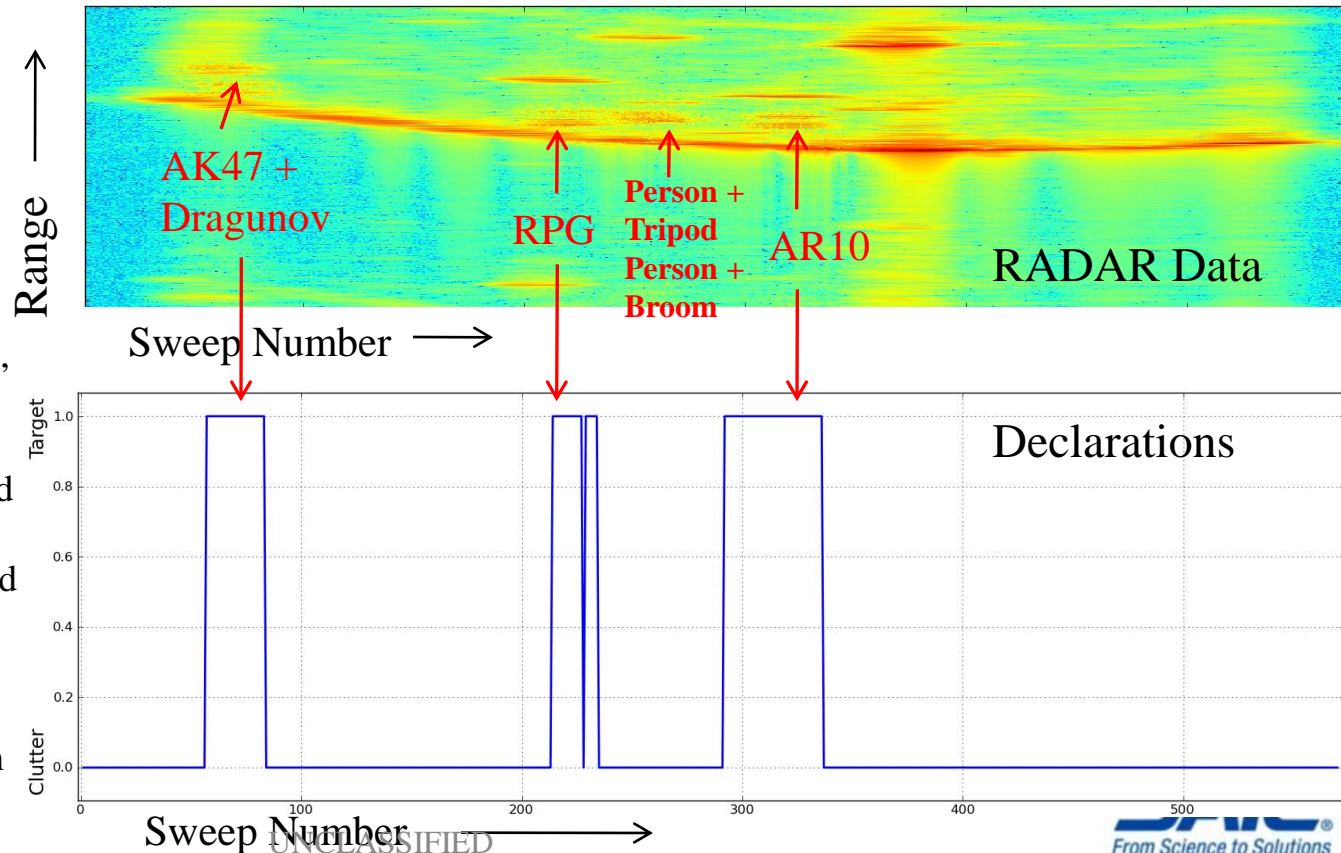
- Dragunov, AK47, RPG, and AR10 detected as weapons
- Person+Tripod declared as clutter
- Person+Broom declared as clutter

Notes

- AK47 and Dragunov in same room



tp9042



Deployed Persons



Window 1 had 2 weapons (AK-47 and Dragunov)

Dragunov in prone position aimed through kill hole



Summary: Algorithm Declarations

	Window 1	Window 2	Window 3	Window 4	Window 5	Window 6	Window 7	Window 8	Window 9	Window 10
Clutter Test, Windows Open										
Clutter Test, Windows Open	Person		Person		Person				Person	Person
Clutter Test, Windows Closed										
Detect Test 1		Dragunov			RPG	Person + Tripod	AK47			AR10
Detect Test 2		RPG			Person + Tripod	AK47	AR10			Dragunov
Detect Test 3	AK47 + Dragunov			RPG	Person+ Tripod Person+ Broom	AR10				

Detection

**Missed Detection/
Outside Search Area**

False Alarm

Confuser

Correct Declaration

Incorrect Declaration

- ❖ All weapons within search range of system were detected
- ❖ No false alarms
- ❖ Automated algorithm used 4 minutes for declarations (non-real time code)

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